WMATA’S Automated Track Analysis Technology & Data Leveraging for Maintenance Decisions
WMATA System

- 6 Lines: 5 radial and 1 spur
- 234 mainline track miles and 91 stations
- Crew of 54 Track Inspectors and 8 Supervisors walk and inspect each line twice a week.
- WMATA’s TGV and 7000 Series revenue vehicles, provide different approaches to automatic track inspection abilities.
Track Geometry Vehicle (TGV)

- Provides services previously contracted out.
- Equipped with high resolution cameras inspecting ROW and tunnels, infrared camera monitoring surrounding temperatures, and ultrasonic inspection system.
- Measures track geometry parameters, and produces reports where track parameters do not meet WMATA’s maintenance and safety standards.
TGV Measured Parameters

- Track gage, rail profile, cross level, alignment, twists, and warps.
- Platform height and gap,
- 3rd rail: height, gage, missing cover board, and temperature.

• Inspects track circuits transmitting speed commands and signals for train occupancy detection with different carrier frequencies and code rates.
TGV Technology

• Parameters such as rail profile, gage distances, 3rd rail and platform gap distances are measured via laser beam shot across running rails, and platforms.

• High-speed/high-resolution cameras take high resolution images of the surface where lasers makes contact with the rail.
TGV Technology

- Track profile is measured via vertical accelerometers, and an algorithm converting acceleration into displacement.
- Track alignment is measured with a lateral accelerometer in combination with image analysis.
- Warps, twists, and cross levels are measured via gyros and inclinometers, along with distance measurements.
Kawasaki 7000 Series Cars

• Cars are assembled into 4-Pack sets for operation.

• 7K cars are equipped with a system of accelerometers that are mounted on 15% of the B cars.

• Vehicle Track Interaction dynamic monitoring system (V/TI) built by Ensco, with primary purpose to identify poor track conditions & ride quality.

Can also identify truck anomalies on vehicle with the technology installed.
7000 Series Track Analysis

• V/TI is capable of measuring any abrupt lateral or vertical movement affecting the axle, truck, or car body where mounted.

• Data sent wirelessly to end user through commercial wayside cellular towers. Provides alerts in case of extreme exceptions.

• The collected data is marked with track location determined via GPS and the vehicle mounted data system (VMDS).

• Data reviewed via protected web application and/ or strip chart.
V/TL Monitoring System

Figure 1: Vehicle/Track Dynamic Monitoring System
### V/TI DATA REPORT

#### Results

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#### Total no. of records 10
V/T I Technology

• Total of 4 accelerometers in each system. 400 Hz sampling rate:
  
  - Car body (one) sensing vertical exceptions from poor vehicle suspension, and lateral accelerations from track alignment. (+/- 2g)
  
  - Truck (one), sensing lateral accelerations and exceptions due to needed truck maintenance. (+/- 5g)
  
  - End of the axle (two) sensing vertical accelerations due to rail profile issues. (+/- 100g)

    Axle vertical exceptions are typically associated with rail head defects, issues with welds, or joints.
V/TI Equipment Positioning

Figure 4: VTI Equipment Positioning

- Main V/TI Unit
- Carbody Sensor
- Truck Sensor
- Axle Sensors
- Antenna
TGV vs. 7K Measuring Systems

- The two technologies measure track conditions, but differences in detail, scope of analysis, and frequency of measurements set them apart and specify their roles.
- The V/TI is revenue vehicle based, provides extensive and continuous measurement coverage through the railroad. Track surface and vehicle conditions.
- The TGV provides a deep level of inspection and analysis, identifying exceptions in track geometry, rail profile, train control circuits, and infrastructure position.
How Is This Data Used?

- Find the unseen problems (Ultrasonic Testing)
- Monitor the state of the track structure and ride quality
- Forecast wear rates and plan certain track maintenance activities
Corridor Infrastructure Management

Collect > Integrate > Analyze

- Assets Register
- Work: Enterprise Asset Management System (EAM)
- Inspection (Track Walker)
- Automated Condition Assessment

CIM System Aggregated Data

Prioritized Work
Automated Condition Assessment

Automated Condition Assessment Data

- Track Geo
- 3rd Rail Geo
- Tie Condition
- Ultrasonic
- Rail Profile
Track Chart

Station Markers

Track Layout
Rail Profile

Station Markers

Track Layout & Assets

18
Analytics

[Graphs and charts showing data analysis for rail transit]

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Analytics

- Raw Data
- Aligned Data
- Rate of Change
Work Prioritization
Work Prioritization
Corridor Infrastructure Management

Automated Condition Assessment

- Track Geo
- 3rd Rail Geo
- Tie Condition
- Ultrasonic
- Rail Profile
QUESTIONS?

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